Using Benchmarking to Minimize Common DOE Waste Streams

Volume II. Used Motor Oil

Prepared for
U.S. Department of Energy
Office of Waste Management
Environmental Management
Waste Minimization Division

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Abstract

Finding innovative ways to reduce waste streams generated at U.S. Department of Energy (DOE) sites by 50% by the year 2000 is a challenge for DOE's waste minimization efforts. A team composed of members from several DOE facilities used the quality tool benchmarking to improve waste minimization efforts. First the team examined used motor oil generation and handling processes at their sites. Then team members developed telephone and written questionnaires to help identify potential "best-in-class" industry partners willing to share information about their best waste minimization techniques and technologies. No industry partners were found that met the team's criteria and would agree to partner with the team, which is an acceptable outcome in benchmarking. Instead, the team performed an internal evaluation of the best management practices and technology to minimize used motor oil.

ACKNOWLEDGMENTS

This report represents the efforts of many participants who shared their talents, time, and resources to further DOE's waste minimization efforts. We thank the following for their contributions:

DOE sponsors

- Kent Hancock and Ker-Chi Chang at DOE EM-334, and Oren Critchfield at DOE/AL
- DOE support staff Patricia Robinson, Paul Deltete, and Troy Eshleman

DOE used motor oil process experts

- James Bennett, Waste Minimization Coordinator, Environmental Office, Martin Marietta Energy Systems(MMES)/Y-12, Oak Ridge, TN
- Gary Bowling, Maintenance Supervisor, MMES/Y-12, Oak Ridge, TN
- Dave Dahlquist, Bus Maintenance Supervisor, former Group Environmental Coordinator of Fleet Management, Idaho National Engineering Laboratory (INEL), Idaho Falls, ID
- Wendy Faler, Group Environmental Coordinator of Fleet Management, INEL, Idaho Falls, ID
- Daniel Gonzales, Fleet Operations Superintendent, Reynolds Electrical Engineering Company (REECO), Las Vegas, NV
- Bill Rose, Project Manager for the motor pool, Sandia National Laboratories (SNL), Albuquerque, NM
- Reggie Tibbets, Maintenance Supervisor, SNL/NM, Albuquerque, NM
- Melissa Armijo, ES&H Coordinator for Motor Pool Services, SNL/NM, Albuquerque, NM

Sandia National Laboratories Process Improvement/Benchmarking Department facilitators

- Lynn Ritchie
- Ken Ronquillo
- Teresa Torres

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Executive Summary

Mission

Recent Executive Orders are challenging U.S. Department of Energy (DOE) facilities to prevent pollution at its source and to use recycled products. DOE continues to seek innovative ways to reduce waste streams generated at DOE sites by 50% by the year 2000.

Project Focus

Sponsored by the DOE's Waste Minimization Division (EM-334), the Benchmarking for Waste Minimization project examines waste minimization techniques and technologies that have been used successfully to minimize used motor oil and provides this information to affected sites within DOE. Benchmarking was the methodology used for analyzing the internal processes and seeking partners that have successfully improved their waste minimization processes.

This report describes the team findings of the best waste minimization practices for used motor oil.

Benchmarking Definition

Benchmarking is the continuous process of improving products, services, and practices by identifying and understanding the current process, exchanging information with recognized leaders in the field, and implementing meaningful improvements.

Benchmarking is used by a variety of companies and organizations as a quality improvement tool. For this project, the following 12-step benchmarking process was used:

1. Identify process to be benchmarked
2. Establish management commitment
3. Identify and establish benchmarking team
4. Define and understand the process to be benchmarked
5. Identify metrics
6. Evaluate current performance
7. Identify potential benchmarking partners
8. Collect process data from potential partners
9. Analyze potential partners' data and choose partners
10. Conduct site visits
11. Communicate results
12. Continue to benchmark the process

Continued on the next page...

Benchmarking Team

A benchmarking team evaluated the current internal processes used at several DOE facilities for used motor oil. The team created a process flow chart and defined process metrics. Using telephone surveys and written questionnaires, the team searched for industry partners with similar working environments that had addressed the problems that the team was investigating. On occasion, benchmarking teams do not find partners that can provide innovative information. The team was unable to find appropriate partners that met the team's criteria and were willing to participate. The team decided to perform an internal evaluation at DOE sites with established used motor oil waste minimization programs.

Results

The team visited the fleet maintenance operations at the Nevada Test Site and Idaho National Engineering Laboratory to learn about their waste minimization practices.

Waste minimization practices included the following:

- Extend the frequency of oil changes by using the upper limit of time and mileage defined by manufacturers' warranties.
- Replace disposable oil filters on buses with permanent filters with removable mesh screens that can be cleaned and reused.
- Purchase motor oil in bulk and dispense oil from a centrally located tank. The pumping system sends oil directly to the maintenance station, allowing quantities dispensed to be monitored and overhead charged back to the correct accounts.
- Drain and crush oil filters before disposal. (Each state has unique regulations.)
- Instead of rags or paper, use cloth towels that can be leased, laundered, and reused. Work with a vendor that has equipment that captures oil from wash water and recycles or reuses the oil.
- Avoid releases to sewer systems or to groundwater by closing all floor drains, using containment berms in storage areas, and disallowing field work on vehicles.
- Use biodegradable detergents in automatic parts washers and steam cleaners instead of manually cleaning with solvents. The machines can recapture oil for recycling.

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Acronyms

BMP	Best Management Practices
COO	Conduct of Operations
D&D	Decommissioning and Decontamination
DOE	U.S. Department of Energy
ES&H	Environment, Safety and Health
FY	Fiscal Year
GPP	Guides to Pollution Prevention
HAZWRAP	Hazardous Waste Remedial Actions Program
INEL	Idaho National Engineering Laboratory
M&O	Management and Operation
MMES	Martin Marietta Energy Systems
NTS	Nevada Test Site
OP	Operating Procedure
PHA	Preliminary Hazard Assessment
PP	Pollution Prevention
REECO	Reynolds Electrical and Engineering Company
SNL/CA	Sandia National Laboratories, California
SNL/NM	Sandia National Laboratories, New Mexico
SOP	Standard Operating Procedure
TCLP	Toxicity Characteristic Leaching Procedure
VMF	Vehicle Maintenance Fleet
WMin	Waste Minimization
WMIS	Waste Management Information System
WS	Waste Stream

1.0 Introduction

1.1 Background

Executive Orders

Executive Orders signed by President Clinton require federal government agencies to prevent pollution at its source and to use recycled products. Executive Order 12856 states that "It is the national policy of the United States that whenever feasible, pollution should be prevented or reduced at the source." On October 20, 1993, President Clinton signed Executive Order 12873 requiring all executive agencies to buy recycled products, including re-refined lubricating oil. The order focuses on federal acquisition, recycling, and waste prevention and is intended "to strengthen the role of the Federal Government as an enlightened, environmentally conscious and concerned consumer." By giving preference to recycled products and eliminating virgin material requirements, the federal government's intention is to expand markets for recovered materials.

DOE Waste Minimization Mission

The U.S. Department of Energy (DOE) has placed a high priority on waste minimization and pollution prevention, encouraging waste generators to develop programs and request adequate resources to effect long-term savings. To provide a strategy for meeting these priorities, the DOE created the Waste Minimization/Pollution Prevention Crosscut Plan (DOE, 1994). The plan states that DOE's waste minimization (WMin) mission is

> "To reduce generation and release of DOE multi-media wastes and pollutants by implementing cost-effective waste minimization and pollution prevention technologies, practices, and policies, with partners in government and industry while conducting the Department's operations in compliance with applicable environmental requirements."

DOE Objective

This benchmarking project helps to accomplish one of the major DOE Crosscut Plan Strategic Objectives which is "to identify and develop technologies and exchange information." The DOE can enhance the effectiveness of WMin efforts by exchanging applicable technologies and information with companies or organizations that are already successful in their WMin/Pollution Prevention approach. A secondary DOE objective is to work closer with U.S. industry.

Sponsor

The sponsor of this project is the DOE Waste Minimization Division, EM-334. The division's mission is to plan, coordinate, and develop a DOE-wide Waste Minimization and Pollution Prevention Program that results in a decrease in the amount of wastes produced by the DOE.

Benchmarking Approach

Benchmarking was chosen as the project approach because it

- has proven capabilities as a quality improvement tool,
- provides flexibility,
- may be applied to many different processes, and
- increases ties with U.S. industry.

For a complete definition of benchmarking and an explanation of the process, refer to *Using Benchmarking to Minimize Common DOE Waste Streams, Volume I, Methodology and Liquid Photographic Waste*, SAND93-3992, April 1994.

1.2 Purpose

Project Purpose

The project's purpose is to

- identify common waste streams throughout the DOE,
- provide a forum for the waste generators who produce the same waste stream at different DOE facilities,
- partner with private industry to learn the best waste minimization technologies that have been applied successfully to these waste streams, and
- provide this information to the DOE.

Benchmarking, a quality tool, provided the methodology for analyzing the internal processes and for seeking industry partners that have successfully improved their own waste minimization efforts.

Report Purpose

This report describes the results of the benchmarking effort to identify the best waste minimization practices for managing used motor oil.

1.3 Report Structure

This document is Volume II in a planned series of waste minimization benchmarking project reports. Volume I includes the background, full project scope, benchmarking methodology, project details such as training and survey techniques, and results of the liquid photographic waste case study. The results of the used motor oil team are included in this report. Additional volumes will be added as other waste streams are studied.

Continued on the next page...

1.3 Report Structure, continued

The following table describes the report structure:

Report Section	Description
1	Project background and purpose.
2	The generic 12-step benchmarking methodology.
3	Project details and results. **See Section 3.11 for waste minimization practices, techniques, and recommendations.**
Appendices	Questionnaires used in the project and a list of resources for more information.

Volume I Has Benchmarking Details

For details on the benchmarking methodology used for this project, read *Volume I, Methodology and Liquid Photographic Waste*. For a copy of Volume I, contact the author at (505) 844-8956 or through the Environmentally Conscious Life Cycle Systems Department, Sandia National Laboratories, Albuquerque, New Mexico.

2.0 Benchmarking Methodology

Introduction

This section is a brief overview of the generic process of benchmarking, as defined by Sandia's Process Improvement/Benchmarking Team.

Benchmarking Definition

Benchmarking is the continuous process of improving products, services, and practices by

- identifying and understanding customer requirements and process performance,
- exchanging information with recognized leaders (internal and external to the organization),
- implementing meaningful improvements, and
- recalibrating the process by assessing the progress and monitoring the trends and results.

Author Robert Camp has defined benchmarking as "the search for industry `best practices' that lead to superior performance" (Camp, 1989).

Benchmarking Steps

Figure 2-1 is a flow chart of the 12-step benchmarking methodology used at Sandia.

Figure 2-1. 12-Step Benchmarking Methodology

2.1 Defining the Benchmarking Process

Benchmarking Process

The following table shows the steps that comprise the benchmarking process. Steps 1 through 6 reflect internal process improvement. Steps 7 through 12 reflect external activities.

Step	Activity
1	**Identify Process to be Benchmarked** The process selected must be narrow enough in scope that it is manageable. The process must be important to the work or business function and be customer-focused because a substantial amount of resources (i.e., personnel, time, and funds) will be required to conduct the benchmark. The result must improve the process and add value.
2	**Establish Management Commitment** Management is defined as the person(s) who has the authority to allocate resources (personnel, time, and funds) and who is ultimately responsible for the outcome of the benchmarking activity. Management • has the responsibility to make the effort to understand the fundamentals of benchmarking and to demonstrate a willingness to implement the results; • needs to support the team and its recommendations with resources, encouragement, and commitment; and • has the right to expect frequent updates from the benchmarking team (e.g., verbal reports, meeting minutes, reports, periodic presentations).
3	**Identify and Establish Benchmarking Team** The benchmarking team members include • **process experts** who have extensive knowledge of the process through their daily jobs; these are the people impacted by any changes. • **resource personnel** such as facilitators, trainers, quality or benchmarking consultants, information specialists, technical writers, and statisticians. • a **project leader** who guides the benchmarking process. The team may need training in benchmarking techniques, including process definition, the benchmarking process, quality tools, questionnaire design, and interviewing techniques. The team members must understand their roles and responsibilities and commit to a common team purpose or goal. The members must attend and participate in all meetings and complete assignments. *Continued on the next page...*

Step	Activity
4	**Define and Understand the Process to be Benchmarked** The team defines the process through an understanding of important process elements: inputs, outputs, suppliers, and customers. The customer drives the business, and therefore the team needs to understand the customers' wants, needs, and expectations. The team's final output for this step includes a process flow chart depicting the work flow and the relationships between people and organizations. The output from this step will lay the foundation for the remainder of the benchmarking activity.
5	**Identify Metrics** The metrics must be meaningful to the process. Example metrics include customer requirements, cost, cycle time, and quality. Metrics, when possible, should be consistent with established standards (i.e., industrial, national, international). The process metrics will aid in evaluating and assessing the current process. Strength and weakness trends developed from the metrics can identify areas for improvement and provide guidance and direction for selecting improvements to be implemented. Effective metrics will provide guidance for developing survey tools for benchmarking partners.
6	**Evaluate Current Performance** The metrics help to identify the process areas to be improved and the nature of the improvements. The team may need to develop a decision matrix for ranking the improvements. A cost/benefit or return-on-investment analysis may be required to evaluate whether the benchmarking process should be continued. If the recommendation for implementation of the appropriate process improvements is made, it will be necessary to monitor the trends and results. Benchmarking does not automatically assume that outside partners are required.
7	**Identify Potential Benchmarking Partners** Based on the metrics collected from the internal process, the team needs to identify and establish criteria for "best in class" partner selection criteria. The team can identify potential partners through numerous resources: database searches and contacts with external organizations, knowledgeable individuals, suppliers, and customers. The team needs to identify a sufficient pool of partners to determine the final few they will visit. Partners that have better processes are not always easily found. A team may discover that their own processes are better than the potential partners' processes. *Continued on the next page...*

Step	Activity
8	**Collect Process Data from Potential Partners** The team develops surveys to obtain preliminary information from potential partners. Surveys may consist of questionnaires, telephone interviews, or face-to-face interviews. (Normally, site interviews are reserved for Step 10.) The survey questions are based on the process metrics and criteria established for selecting partners. Up-front planning on how to analyze the quantitative and qualitative data is essential for developing good surveys.
9	**Analyze Data and Choose Partners** The preliminary data are used to select partners for site visits and interviews. The project leader compares the data gathered from the potential partners to the metrics and criteria set by the team. The final partner(s) must have a process that is applicable to various DOE sites. The project leader should make direct comparisons of the data, process parameters, and constraints. The team will analyze the data and determine weighting and ranking criteria in order to select the final partners. If the team cannot find a partner that can provide substantial process improvements, the team needs to rethink the project. The team may decide • to repeat several steps, which includes revising the criteria, expanding the pool of potential partners, collecting new process data, and re-analyzing the data in the search to find appropriate partners; or • to conduct an internal evaluation; or • to terminate the benchmarking effort.
10	**Conduct Site Visits and Reanalyze Data** To gain the maximum benefit from partner site visits, careful and thorough preparation is essential. Preparation includes, but is not limited to, determining appropriate interviewees, assigning team interviewing roles, developing a list of questions and a meeting agenda, and determining how to handle the interview data. The site visit is an opportunity for two-way communication between the benchmarking team and each partner. During the site visit, the team will conduct an in-depth interview. It is essential that the team develop an effective interview guide for each partner before the site visit. After all partners' information is collected, the quantitative and qualitative data are analyzed. A decision matrix may be used to identify and select the partners' practices to be incorporated. *Continued on the next page...*
11	**Communicate Results** The team reports results to upper management and all involved parties and develops an action plan that describes the team's recommendations, methods for implementation, and implementation costs and schedule. The findings need to be adaptable to the process and the organization's culture and constraints. The improvements need to be monitored and evaluated.

Step	Activity
12	**Continue to Conduct Benchmarking of Process** The best process today may not be the best process tomorrow. Depending on the amount of change in the process, customer requirements, competition, technological advances, and changing business practices, it is important to revisit the process, or specific aspects of the process, periodically.

Reference

This section is an adaptation of Section 2 of the report, *Benchmarking the Property Inventory Process at Sandia National Laboratories*, SAND92-2565 (Ramirez and Hill, 1993). It describes the generic process of benchmarking, as defined by Sandia's Process Improvement/Benchmarking Department.

3.0 Used Motor Oil Benchmarking Results

Adaptation of Benchmarking Methodology

The 12 steps of the benchmarking methodology listed in Section 2 provide the framework for this project.

Benchmarking is a flexible process that lets each team adapt the standard procedure to the unique needs of the project.

The following describes how the used motor oil team used the benchmarking process to collect information on Best Management Practices and other techniques and technologies for minimizing used motor oil within DOE.

3.1 Step 1: Identify Process to be Benchmarked

DOE's Waste-Generating Activities

Figure 3-1 illustrates four major types of waste-generating activities within the DOE, including:

- mission-related,
- waste management,
- environmental remediation, and
- infrastructure-related.

Infrastructure-related activities are the DOE's "landlord" activities as shown in the lower portion of Figure 3-1. Infrastructure-related activities were chosen because they have not yet received the same DOE-wide attention that the other three waste-generating activities have received. These activities produce DOE-wide waste streams that are also produced in outside industry. Therefore, they are ideal activities for benchmarking because appropriate industry partners should be easy to identify and locate.

Figure 3-1. Waste-Generating Activities in DOE

Identification of Common Waste Streams

Initial activities centered on collecting information on as many DOE waste streams as possible. Refer to Volume I for the detailed rationale for selecting used motor oil as one of the first waste streams for benchmarking.

☞ OUTCOME OF BENCHMARKING STEP 1:

Process chosen for benchmarking:

- Used motor oil generation

3.2 Step 2: Establish Management Commitment

Strong DOE Commitment

Because of DOE's emphasis on waste minimization, management commitment was a positive element in this project. The DOE sponsor for this project is the Waste Minimization Division, EM-334. Management support included the following:

- Headquarters provided project funding and guidance.
- The Albuquerque Field Office provided support through the WMin coordinator.
- Site management allowed the process experts the time to participate.
- Sandia management provided benchmarking expertise and trainers.

☞ OUTCOME OF BENCHMARKING STEP 2:
DOE management committed resources at local, regional, and national levels.

3.3 Step 3: Identify and Establish Benchmarking Team

Team Members

A benchmarking team usually consists of a project leader, process experts, management, and support personnel. Not all team members are required to participate at all times. Some team members may perform more than one role, as needed, for the team at large and smaller subteams.

Finding Team Members

The project leader used the following sources to find benchmarking team members:

- Networking
- Contacts within the DOE
- Proceedings from waste minimization conferences
- Discussions with site waste minimization coordinators

Roles and Responsibilities

The following table outlines suggested roles and responsibilities needed for a benchmarking effort.

Role	Responsibilities
Project Leader	Plan, organize, assign tasks, and oversee the benchmarking project.
Process Experts	Provide professional expertise on the target process during the workshops, contact industry partners, and conduct site interviews.
DOE Management	Set policy and provide support, personnel, time, and funding.
Trainers/Facilitators	Teach participants benchmarking techniques and lead workshops and work sessions to accomplish goals.
Information Specialist	Aid the search for potential benchmarking partners through database searches.
Writer/Recorder	Document the benchmarking process by recording workshop activities and provide support for project leader, as needed.

Continued on the next page...

Team Roster

The following table lists the used motor oil team members:

Team Member	Title	Location
Melissa Armijo	ES&H Coordinator for Motor Pool Services	SNL/NM, Albuquerque, NM
James Bennett	Waste Minimization Coordinator, Environmental Office	MMES/Y-12, Oak Ridge, TN
Gary Bowling	Maintenance Supervisor	MMES/Y12, Oak Ridge, TN
Dave Dahlquist	Group Environmental Coordinator, now Bus Maintenance Supervisor	EG&G INEL, Idaho Falls, ID
Daniel Gonzales	Operations Supervisor of Motor Pools, ES&H Coordinator	REECO, Las Vegas, NV
Victoria Levin	Project Leader, Environmentally Conscious Life Cycles Systems	SNL/NM, Albuquerque, NM
Bill Rose	Project Manager for the Motor Pool	SNL/NM, Albuquerque, NM
Reggie Tibbetts	Maintenance Supervisor	SNL/NM, Albuquerque, NM

☞

OUTCOME OF BENCHMARKING STEP 3: Planning team, benchmarking team, and interview team successfully assembled.

3.4 Step 4: Define and Understand the Process to be Benchmarked

Process Foundation

Step 4 lays the foundation for all future activity. The team must define and understand the existing process before examining another's process. This step establishes the baseline from which to measure performance gaps.

Workshop Activities and Goals

The project leader, benchmarking consultants, process experts, information specialist, and support staff attended a workshop that provided training and a work session for the entire team, covering several benchmarking steps.

The goals of the first workshop were to

- Define and understand the process to be benchmarked (Step 4),
- Create a flow chart of the generic process (Step 4),
- Define the metrics of the process (Step 5), and
- Define the criteria for choosing potential partners (Step 7).

The table below summarizes the workshop activities. A detailed description of the activities follows the table.

Stage	Activity
1	Workshop facilitators directed team-building exercises to integrate the team into a cooperative, working unit.
2	Workshop facilitators trained the team in the benchmarking methodology so that team members understood the group process, the task, the commitment, and the work involved to complete the project.

Stage 1 — Team Building

Team Building

The team-building exercise resulted in a team name, motto, and mission statement.

Team Name	The Slick Team
Motto	Used Oil is a resource.

Stage 2 — Train the Process Experts

The process experts were chosen for their knowledge of their fields and the tasks they perform in their daily jobs. However, they needed training in the benchmarking process.

Stage 3 — Create a Consensus Flow Chart

Process Flow Chart

The process experts came from a variety of sites that used different procedures to accomplish the same task: changing oil for their customers. The team needed to create a flow chart that expressed the process "big picture." The facilitator helped the group define the process parameters.

Process Parameters

All processes have the following common parameters:

- Inputs
- Suppliers
- Outputs
- Customers

The team used the parameters above to help them define the particular process that produces the used motor oil waste stream. For each parameter, the team brainstormed for ideas. After making a list for each parameter, the group reviewed each listed component to confirm that it was directly related to the used motor oil waste stream, not a side issue. The mission statement provided a reminder for keeping the group focused. The final lists are shown below.

Inputs

Inputs for the used motor oil waste stream include:

- New oil
- Filter
- Work/labor
- Equipment
- Time interval between oil changes
- Preventative maintenance systems
- Oil analysis
- Manufacturers' specifications
- Warranties
- Training

Suppliers/ Drivers

Suppliers/drivers for the used motor oil waste stream include:

- Oil manufacturers
- NAPA (oil supplier)
- Equipment manufacturers
- DOE (Regulation 5700.6C)
- Vehicle fleet maintenance staff

Continued on the next page...

Customers

Customers of the used motor oil waste stream include:

- Vehicle operators
- Owners of the fleet
- Regulatory agencies (the public, environmental)
- Site management

Outputs

Outputs of the used motor oil waste stream include:

- Used oil
- Vehicle with clean oil
- Documentation/reports

Flow Chart

After the lists were finalized, the team created a flow chart (Figure 3-2) that diagrams the used motor oil generation and handling process.

☞ OUTCOME OF BENCHMARKING STEP 4:

Used motor oil process inputs, outputs, customers, and suppliers were identified. A flow chart of the process was completed.

Figure 3-2. Used Motor Oil Generation and Handling Process

3.5 Step 5: Identify Metrics

Definition

Metrics are the measures of the internal process. Metrics allow evaluation and assessment of existing performance and provide points of contrast after the lessons learned from the benchmarking activity have been applied.

Metrics

After the process flow chart was created (see Step 4), the facilitator led the team through a discussion of the metrics that applied to its process and defined a list of metrics.

The group decided that the following metrics were relevant:

- Volume of oil—bulk in and bulk out
- Usage conditions that determine frequency of oil changes:
  - Vehicles may run 24 hours a day, all week
  - Severe service conditions
  - State requirements for specialized vehicles such as ambulances
  - Mileage or time frame
- Oil characterization
  - TCLP (Toxicity Characteristic Leaching Procedure)
  - Moisture
  - Metals
  - pH
  - Radioactivity
- Oils
  - Type
  - Brand
  - Viscosity
- Trend analysis
  - FTE hours per vehicle
  - Materials used, such as filters and containers
  - Engine failures
  - Operating conditions
- Equipment type
- Maintenance service records
- Miles driven vs. volume of oil used
- Efficiency—How quickly is the vehicle serviced and returned to the customer?

NOTE: Not all the metrics are easily obtainable within DOE.

☞ OUTCOME OF BENCHMARKING STEP 5:

The team defined used motor oil metrics that provide the measures of the internal process.

3.6 Step 6: Evaluate Current Performance

Information Exchange

The team performed an informal evaluation of each site's performance by exchanging information and comparing activities and processes. Each process expert had the opportunity to discuss and explain his or her site process during the first workshop.

Value of Workshop

The participants identified how the workshop helped them to:

- learn new ideas through hearing about other sites' processes
- gain a networking opportunity for sharing ideas
- understand differences among state environmental laws and regulations. For example, a practice that was followed in one state might not be allowed in another state.

Learning to Ask "Why?"

One of the actions that benchmarking proposes is asking "Why?" Participants are encouraged to ask, "Why do we perform this step in the process in this way?" Often, the answer is "Because that's the way we've always done it in the past." Benchmarking tries to train participants to "think outside of the box" and find new ways to accomplish the same task more efficiently and cost effectively.

Nevada Test Site Success Story

After the first workshop, Daniel Gonzales, the participant from the Nevada Test Site (NTS), reported that he successfully applied the principles learned in the workshop, resulting in a monetary and resource savings. The success story follows:

NTS purchased three new transformers that had 15,000 gallons of oil already in the machines. Originally, the site planned to dispose of the oil as hazardous waste at a cost of $10.22 per gallon, just as it had done in the past.

Gonzales questioned the need for disposing of the oil and suggested that most of the oil could be utilized in the transformers as part of normal usage. He suggested that management reevaluate some of the practices that had been followed in the past. Most of the oil did not have to be disposed of because it could still be used in the transformers. The oil that did require disposal did not require hazardous waste treatment because the level of contamination was below regulatory levels. Gonzales suggested that NTS could dispose of the oil in keeping with regulatory and environmental concerns at less cost.

After notifying his supervisor, he began to investigate alternatives for using some of the transformer oil and disposing of the remainder. One of his current vendors, a Part B-permitted vendor with cradle-to-grave disposition, removed 6,500 gallons of the oil at a cost of 15 cents per gallon.

The cost savings was $64,455. Later in the year, another 3,500 gallons was removed, bringing the total savings to $100,700.

☞ OUTCOME OF BENCHMARKING STEP 6:

- Individual team members shared information on each site's process and established network contacts for future problem solving.
- NTS reevaluated disposal processes and was able to cut costs in transformer bi disposal.

3.7 Step 7: Identify Potential Benchmarking Partners

Search Parameters

Criteria are defined as standards on which a judgment or decision may be based (Webster's, 1985). The team developed criteria to be used to identify appropriate potential partners.

Defining the criteria limited the search to partners that fit the team's needs. The used motor oil team wanted to find a partner that serviced a variety of vehicles and equipment that operated under extreme weather and service conditions.

Criteria

The used motor oil team defined the following criteria for potential partners:

- Willing to participate
- Vehicles similar to those at the DOE sites
  - Light
  - One ton
  - Greater than one ton
- Heavy equipment, such as cranes and construction equipment
- Multiple service areas
- At least 500 pieces of equipment
- Mixed fuel use
  - Propane
  - Natural gas
  - Gasoline
  - Diesel
  - Electric
- Fleet maintenance service company with an oil reclamation program
- Oil reused in a closed-loop system (preferable but not required)
- Alternate means of reusing oil
- Synthetic oil used successfully (preferable but not required)
- Lowest volume of oil used per vehicle mile
- Successful in extending their service frequencies

Information Sources for Identifying Potential Partners

A variety of methods and sources for identifying potential partners, including the following, were used:

- Literature search by an information specialist
- Process experts' suggestions
- Contacts through customers or suppliers
- Trade associations or publications

☞ OUTCOME OF BENCHMARKING STEP 7:
A list of 16 potential partners was finalized.

3.8 Step 8: Collect Process Data from Potential Partners

Data Collection Methods

In benchmarking, the main tool for gathering initial process data from potential partners is a questionnaire, either verbal or written. Both types were used for this project.

Questionnaire Development Training

The benchmarking team reconvened to learn questionnaire development techniques and to define the questions to pose to potential partners.

Refer to Volume I, Appendix B, for an abbreviated training guide on questionnaire development techniques. Refer to Appendix A in this volume for the final telephone and written questionnaires used in this project for used motor oil.

Questionnaire Development Process

The group discussed questions that would help them find the benchmarking partners. The group needed two questionnaires:

- a telephone questionnaire to act as a filter to determine industry partner interest and broad suitability and
- a written questionnaire that would elicit detailed information to help determine the final candidates for site visits.

Telephone Questionnaire Purpose

The telephone questionnaire served as a brief means to determine whether a company was interested in participating and whether it was suitable for benchmarking. The telephone questionnaire provided a filter, focusing on major processes rather than the details of the company's operations.

Written Questionnaire Purpose

The purpose of thewritten questionnaire was to collect the needed information to choose the best partner.

The written questionnaire incorporated most of the metrics defined in the first workshop on process definition. The written questionnaire was sent only to the companies contacted by telephone that

- met some of the criteria and
- expressed an interest in participating

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Metrics and Criteria Provide Foundation

The metrics and criteria provided the basis for the questions. Reviewing the metrics helped the team create the questions.

Questionnaire Issues

- One of the first questions to be answered was whether or not the industry partner would be **interested in participating** in a benchmarking project.

- Should the group base the questions on the **volume** of used oil or purchased oil? One person suggested a trend analysis of oil purchased over the last five years. Several team members noted that the amount of oil purchased is almost the same as the used amount produced.

- The group discussed a **minimum fleet size or volume of oil purchased** as a possible criterion for a partner. Another member remarked that the group might limit themselves if they overlooked an independent operator with 30 vehicles who might be doing a terrific job of used oil minimization.

- The group discussed the **recycling options** currently available, such as oil burners for heating and mixing used motor oil with diesel fuel (used motor oil can provide up to 10% of the volume of diesel fuel through 1995).

- The group discussed whether the **interval between oil changes** should be judged on time elapsed or frequency of vehicle use (miles or hours driven).

- **Service conditions** were important to the group. Environmental metrics included:
  - dusty, corrosive conditions
  - extreme cold/extreme heat (temperature) fluctuations
  - water in the oil pan

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Questionnaire Process

The following table describes the process for developing and using both telephone and written questionnaires:

Step	Team Member	Action
1	Process Experts	• Use the metrics to develo • Using process knowledge, make sure the questions will help identify good partners and are not just "nice to know" information
2	Project Leader and Technical Writer	• Use the rough questions developed at the workshop to create the telephone questionnaire and the written questionnaire
3	Project Leader	• Divide the names and tel potential partners among the process experts (2 or 3 per process expert) • Fax the final version of the telephone questionnaire to the process experts • Send a rough draft of the written questionnaire to the process experts for comment
4	Process Expert	• Review and edit telephon questionnaires • Call the companies and conduct the telephone questionnaire • Report the results to the project leader • Review the written questionnaire and send the suggestions to the project leader

Results

Of the 16 initial contacts made by the used motor oil team by telephone, none of the companies seemed to be a good match for a benchmarking partnership. For example, only two of the potential partners maintained their own fleet, which automatically excluded 7 of the 12 criteria. These 7 criteria were:

- Vehicles similar to those at the DOE sites
- Heavy equipment, such as cranes and construction equipment
- Multiple service areas
- At least 500 pieces of equipment
- Fleet maintenance service company with an oil reclamation program
- Overall lowest volume of oil used per vehicle mile
- Successful in extending their service frequencies

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Results, continued

Three companies had processes that seemed adequate for comparison to the DOE's process as defined by the process experts, but they did not meet more than half of the criteria. Other companies were not willing to participate further.

Written questionnaires were sent to three companies; none were returned. (This return rate is well below the average return rate of 30-60% for prescreened written questionnaires.) The team did not pursue a follow-up interview because the companies would not be ideal partners.

☞ OUTCOME OF BENCHMARKING STEP 8:
The team conducted 16 telephone questionnaires. Three written questionnaires were sent

3.9 Step 9: Analyze Potential Partners' Data and Choose Partners

No Potential Partners Match Criteria

The limited process data collected from potential partners through questionnaires did not produce any appropriate candidates for benchmarking.

At the time of the telephone questionnaire, it was apparent that none of the potential partners was suitable. None of the telephone interviews had produced candidates that had practices or technologies that were not already in use at several of the DOE facilities. Three written questionnaires were sent out, even though the team members did not expect to discover new waste minimization data.

Team Considers Options

Because of the lack of appropriate external partners, the team faced a dilemma. When the team convened for training on interview techniques for the site visit, they discussed alternatives, including widening the search for potential partners. The team proposed a variety of partners, including several cities and large corporations, but rejected them, because they did not have enough process data to make a decision. Also, many cities and large corporations that have vehicle fleets contract the maintenance and are not responsible for handling used oil. The process expert from Idaho National Engineering Laboratory (INEL) mentioned that representatives of fleets at major metropolitan centers and local municipalities have contacted INEL for information about processing used oil. The team members felt that strict regulations for government facilities and DOE's emphasis on waste minimization have encouraged DOE facilities to become proactive in solving waste minimization problems.

Team Chooses Internal Evaluation

The team decided to perform an internal evaluation at two of the DOE facilities, INEL and NTS. The intent of the internal evaluation would be to gather information about key waste minimization techniques and best management practices that could be applied to other DOE sites. These two sites were chosen for the internal evaluation because during the benchmarking workshops, the INEL and NTS process experts described a variety of machines and practices that were already reducing used motor oil. The team decided to visit these two sites.

OUTCOME OF BENCHMARKING STEP 9:

No industry partners matched the criteria set by the used motor oil team. The team decided to perform an internal evaluation at the

- Idaho National Engineering Laboratory
- Nevada Test Site

3.10 Step 10: Conduct Site Visits

Introduction

The interview team, a subset of the benchmarking team, received training on interview techniques, rules of conduct, and agenda development skills. The interview team traveled to the INEL and the NTS to gather information on best management practices and processing techniques for used motor oil.

- For an abbreviated training guide on on-site interviewing techniques, refer to Volume I, Appendix D.
- For the motor oil team's final interview question set, refer to Appendix B of this document.

Tables containing comparisons of INEL and NTS processes follow the summary paragraphs below.

3.10.1 Idaho National Engineering Laboratory Site Visit

The first site visit was performed at INEL near Idaho Falls, Idaho. Dave Dahlquist, previous Group Environmental Coordinator, conducted a tour of the facilities and answered the interview questions.

Summary of INEL Visit

The agenda for the INEL visit covered the following:

- Tour of main fleet maintenance shop at Scoville, Idaho. The vehicle maintenance shop provides all fleet maintenance services, including fueling systems, painting, body work, welding, fabrication, tire work, lubrication, upholstery, and engine rebuilding. The site also has 14 satellite areas that provide some of the same services.
- Interview of Dave Dahlquist, previous Group Environmental Coordinator
- Closeout

3.10.2 Nevada Test Site Site Visit

The second site visit was performed at the Nevada Test Site near Las Vegas, Nevada. Daniel Gonzales, Fleet Maintenance Supervisor, conducted a tour of the facilities and answered the interview questions.

Summary of Nevada Test Site Site Visit

The agenda for the NTS site visit covered the following:

- Tour of fleet maintenance operations. The operations have two buildings that provide light duty (vehicles one ton and under) and heavy duty (over one ton) maintenance. The shops have capabilities to provide all maintenance, including painting, upholstery, prefabrication, modifications, and engine rebuilding. The team visited the following shops in Building 751: body; fuel, lubrication, and oil; tire; welding; and engine rebuild
- Interviews of key personnel in fleet maintenance operations
- Closeout

Process Comparison of INEL and NTS

The following tables provide comparisons of the working environments, motor oil and oil filter usage and disposal practices, and related information at INEL and NTS.

Table 3.1 Description of Working Environment

Category	Idaho National Engineering Laboratory	Nevada Test Site
Number of work areas	14 satellite areas, 1 central maintenance shop	10 shops in 2 main areas
Severe service conditions	• Dust, extreme heat and cold from snow and ice, volcanic ash, sand, some 24-hour vehicle duty	• Wind, dust, extreme heat and cold, snow, rain
Number of vehicles and equipment	• Buses 179 • Light duty (one ton or less) 842 • Heavy duty (> one ton) 464 • Total 1575	• Light duty (one ton or less) 1944 • Heavy duty (> one ton) 393 • Total 2337
Types of light-duty vehicles serviced	• Vans, cars, light trucks	• Station wagons, cars, light trucks
Types of heavy equipment serviced	• Buses, road equipment, helicopters, tractors, generators, trailers, snowplows, forklifts, cranes, utility trucks, dump trucks, belly dumps, scrapers	• Buses, tractors, generators, trailers, snowplows, forklifts, cranes, utility trucks, dump trucks, belly dumps, scrapers

Table 3.2 Description of Oil Usage and Disposal

Category	Idaho National Engineering Laboratory	Nevada Test Site
Type of motor oil used	• Various, low-bid, vendor-supplied	• Various, low-bid, vendor-supplied
Annual purchases of new motor oil	• 17,000 gallons (other purchases of oil may be made by the crafts groups, which the shop does not control)	• 65,000 gallons (NTS has experienced recent downsizing. At one time, NTS purchased 120,000-150,000 gallons per year.)

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Table 3.2 Description of Oil Usage and Disposal, continued

Category	Idaho National Engineering Laboratory	Nevada Test Site
Annual used motor oil produced	• 12,000-15,000 gallons	• 58,500 gallons
Disposal of used motor oil	• Vendor picks up used oil and transports it to another customer for use in furnaces for energy recovery.	• Holds oil in storage tanks for recycler pick-up. NTS has four 2,000-gallon tanks and two 5,000-gallon tanks placed near shops for collecting used oil. The tanks have dedicated plumbing to siphon the oil directly from the shop to the tank. Oil is re-refined by vendor.
Costs for storage and disposal of used motor oil	• Vendor charges $.01 per gallon to pick up used oil at an annual cost of approximately $150 per year	• Approximately $10,000 per year
Interval for oil changes	• Severe service, every 3,000 miles • Normal service, buses, every 12,000 miles • Normal service, light vehicles, 6,000 miles or 6 months	• 6,000 miles or 24 months
Oil Characterization	• Analyzes for residuals to predict and thereby prevent engine problems • Toxicity Characteristic Leaching Procedure (TCLP) analyticals can provide trend information. Conducted biannually.	• Chlordetect (checks for the presence and percentage of chlorine in the used oil.) • Gamma (checks for radioactivity.)

Table 3.3 Description of Filter Usage and Disposal

Category	Idaho National Engineering Laboratory	Nevada Test Site
Type of filters used	• Canister • Spin-on filters • Low-bid vendor • Permanent filters with washable screens (on approximately 50 buses)	• Canister • Spin-on filters • Low-bid vendor
Interval for filter changes	• Same as oil change schedule	• Same as oil change schedule
Disposal of used filters (State regulations determine most disposal procedures.)	• Drain 48 hours, crush, landfill	• Drain 24 hours, crush, drain 24 hours, landfill

Table 3.4 Miscellaneous Process Information

Category	Idaho National Engineering Laboratory	Nevada Test Site
Manufacturer's warranty issues	• Stays at the upper limit of manufacturer's recommendations and works with the manufacturer • Manufacturer signs an agreement at the time of vehicle purchase that allows INEL to determine oil change frequencies while maintaining the warranty	• Stays at the upper limit of manufacturer's recommendations and works with the manufacturer
Regulatory constraints	• Same as other DOE sites, but more stringent than private industry	• State regulators have rigorous requirements and have sometimes had incorrect information. At one point, the regulators were concerned that NTS was land-filling oil filters with lead content. However, by performing research and supplying documentation, NTS was able to prove they were not using lead-containing filters, which had not been manufactured for two years. *Continued on the next page...*

Table 3.4 Miscellaneous Process Information, continued

Category	Idaho National Engineering Laboratory	Nevada Test Site
Using re-refined oil?	• Not presently, but is pursuing information	• Not presently, but has submitted a request for information and a cost analysis form to a vendor to determine feasibility.
Waste minimization techniques and technologies that the site would like to implement	• Retrofit more vehicles with washable filters • Buy a heater to burn used oil • Sell waste metal • Substitute blotter paper for cloth or sponge products to absorb spills • Acquire a sampling unit for in-house oil analysis	• Install permanent filters with washable screens to eliminate the need to drain and landfill disposable filters.

☞ OUTCOME OF BENCHMARKING STEP 10:
The interview team completed site visits at

- Idaho National Engineering Laboratory

3.11 Step 11: Communicate Results

Overview

This section presents what was learned from the site visits. Both key minimization options and Best Management Practices (BMPs) are included.

Normally, Step 11 of the benchmarking methodology includes implementing improvements and monitoring the results. In this case, implementation is not within the project scope. However, because of the ideas shared in this study, another participating site is planning to incorporate some of the techniques that may be applied to its process.

This section provides results and offers options so that individual sites may create their own implementation plans.

NOTE: A portion of the information in this section was adapted from the *DOE Pollution Prevention Vehicle Maintenance Handbook*, 1994.

3.11.1 Waste Minimization Practices

The following tables provide information and a comparison of the various best management practices, techniques, and key minimization options in use at INEL and NTS. Key minimization options discussed were (1) source reduction and (2) recycle/recovery. The tables include:

Continued on the next page...

Table Number	Table Description
3.5	Source Reduction
3.6	Recycle/Recovery
3.7	Solid Waste Related to Used Motor Oil Process
3.8	Spills and Leaks
3.9	Cleaning

Motor Pool Services Waste Minimization Practices

Table 3.5 Source Reduction

Description	INEL	NTS
Routine oil changes are the largest source of used oil for both facilities. Solution: Reduce the number of oil changes.	• Uses upper limit of manufacturer's warranty specifications. • INEL requires vehicle vendors to sign an agreement at the time of purchase, allowing INEL to use its own oil change schedule. Oil analysis helps INEL diagnose engine problems before they result in failures.	• Uses upper limit of manufacturer's warranty specifications.

Table 3.6 Recycle/Recovery

Description	INEL	NTS
Collect oil for pickup by a recycler	• Oil vendor removes used oil for energy recovery. Cement factory uses oil as fuel for furnaces.	• Vendor removes used oil from central collection tanks and re-refines it.

Motor Pool Services Waste Minimization Practices, continued

Table 3.7 Solid Waste Related to Used Motor Oil Process

Type of Waste	INEL	NTS
Plastic Oil Bottles	• Refills plastic oil bottles instead of throwing them away. Quart- and gallon-sized oil bottles provide convenience at fueling stations, but do not generate waste because they are refilled from centrally located 55-gallon drums of bulk products. Bottles can be used for years.	• Plastic bottles have been almost eliminated. Purchases motor oil in bulk and stores in centrally located tanks. Mechanics can move the oil into smaller containers or dispense it directly into vehicles. NTS has a pumping system that sends it directly to the maintenance station from a central location, allowing quantities dispensed to be monitored and overhead charge-back to the correct accounts.
Oil Filters (A used oil filter holds approximately 10 ounces of used oil.)	• Replaced disposable oil filters on 50 buses with permanent Oberg filters with removable mesh screens. The screen is cleaned and reused. The residue captured in the screen may also be analyzed for indications of future engine problems. The cost of retrofitting a bus with a permanent filter is roughly $500. This strategy reduces solid waste caused by disposable filters, saves labor costs associated with standard oil and filter changes, and enhances the engine cooling process. • Drains filters for 48 hours, crushes them in a filter press, accumulates them in 55-gallon drums, and sends drums to a landfill.	• Drains filters for 24 hours, crushes them in a filter press, and drains them for another 24 hours. Specially installed plumbing pumps the drained oil directly to an above-ground used oil storage tank. The crushed filters are accumulated in 55-gallon drums and eventually sent to a landfill. The cost of a filter press is approximately $3,000.
Shock absorbers	• Drills holes in used shock absorbers and drains the oil 48 hours before recycling the metal.	• Not applicable

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Table 3.7 Solid Waste Related to Used Motor Oil Process, continued

Type of Waste	INEL	NTS
Towels, rags, or paper wipes	• To reduce paper sent to landfill, INEL leases cloth towels from a supplier that will also launder them. The cloth towels eliminate oily paper towels that were previously disposed of as hazardous waste. The same vendor launders work coveralls. INEL has made sure that the service vendor is using proper procedures to prevent discharge of oil to the sewer system. • Instead of using vermiculite or blotter paper to soak up spills in the shop, INEL uses a squeegee and a wet/dry vacuum that has been made explosion-proof, then recycles the captured oil.	• Uses biodegradable towels that are like paper, but decompose quicker in landfills. Local regulations do not permit washable towels.
Hydrocarbon soils	The soil is analyzed and, based on the degree of contamination, it may be: • sent to the landfill as backfill dirt, • farmed (lay the soil out and periodically turn it over to let it evaporate), or • placed in 55-gallon drums and handled as hazardous material.	• Hydrocarbon soil is placed in a dumpster-type container and periodically hauled to the Class 3 hydrocarbon landfill on site. By using the dumpster, NTS has eliminated buying drums and avoided more solid waste in the landfill.
Plastic hoses	• INEL has a sampling process for oil and has installed valves in some vehicle engines that let mechanics draw a small oil sample. This process avoids spills and contamination of plastic hoses normally used for oil sampling.	• Not applicable

Table 3.8 Spills and Leaks

Circumstances	INEL	NTS
Spills and Spill Avoidance	• Uses drip pans to catch oil. • Has spill kits available at all service areas and on all service trucks • On some vehicles, engine valves have been installed that allow mechanics to draw small oil samples, avoiding spill opportunities.	• Uses drip pans to catch oil. • Follows mandated general spill response procedure and in-house guidance documents for specific situations.
Avoiding discharges to sewer system	• Closes all floor drains to avoid accidental releases of oil to the sewer system.	• Closes all floor drains to avoid accidental releases of oil to the sewer system.
Avoiding releases to groundwater	• Uses secondary containments;, for example, all tanks are double-walled and all 55-gallon drums are in secondary 85-gallon overpacks. • Does not allow any field work on vehicles.	• Modified fittings on the used oil storage tanks to specifically match the recycler's fittings on the transport truck. At NTS, the couplings on the storage tank were modified to reduce the chances of spills or leaks. • Uses containment berms to prevent accidental spills from running off cement floors or asphalt areas or from being washed by rainwater onto the ground where groundwater contamination could occur. • Does not allow any field work on vehicles.

Table 3.9 Cleaning

Category	INEL	NTS
Engines	• Steam cleans engines. Uses a grease/water separator to remove oil. Residual sludge is tested before it is solidified and taken to local landfill. Uses hot water and biodegradable soap in an area designated for this purpose. The runoff is collected in a sump that separates the water and sludge. The sludge is analyzed for hazards, solidified, and sent to a landfill.	• Steam cleans engines with a sump pump and steam cleaner at a steam pad. This closed-loop system captures all runoff, preventing releases to the environment. Water is separated and reused. After analysis for any hazardous waste, residual sludge is sent to a hydrocarbon landfill.
Floors	• Uses a closed-loop floor cleaning system that filters and reuses its own water.	• Uses a closed-loop floor cleaning system. The spill is mopped up and cleaned with a biode-gradable soap. The water is separated and reused and the oil is skimmed and sent to recycle.
Parts	INEL uses two parts washers: • The small-parts cleaner is a hood-type, operated from outside of the mechanism. Built-in gloves eliminate worker exposure to hazards. • The large-parts washer uses a rotary-type tray (such as a dishwasher). Both systems use non-toxic cleaners and hot water. The accumulated residue is analyzed, solidified, and sent to the landfill.	• Uses an automatic parts washer to cut worker exposure to hazardous chemicals. Used oil is recovered from the cleaning fluid with oil separators. Sludge is removed, tested, and landfilled. Water is reused.

Table 3.10 Miscellaneous Waste Minimization Practices

Methods	INEL	NTS
Electronic database	• An electronic database tracks maintenance, service, and vehicle condition reports.	• An electronic database at NTS provides on-line repair and maintenance information.
Training	• Trains all personnel in proper used oil handling and spill-avoidance techniques. • Uses a recognition program that rewards and recognizes individuals that seek innovative pollution prevention strategies.	• Trains all personnel in proper used oil handling and spill-avoidance techniques • Uses a recognition program that rewards and recognizes individuals that seek innovative pollution prevention strategies.
Visit vendors to ensure that the promises made are kept	• Works with their laundry contractor (for towels and coveralls) to ensure that no oil is discharged to the Snake River. The contractor uses a filtration and skimming device to remove oil and sediments before releasing waste water. The contractor is monitored three times weekly to ensure continued compliance. Intense cradle-to-grave records are kept as proof.	• To ensure that vendors are properly handling used motor oil, NTS visits prospective vendors to review their operations area. NTS makes sure there are audit trails to ensure cradle-to-grave tracking.
Know your process thoroughly	• Operators evaluate each of the tasks that generates a waste stream to determine if there is another way to perform that task to reduce the amount and/or toxicity of the waste generated.	• Research, documentation, vendor information, and process knowledge are used to reduce the amount of and/or toxicity of the waste generated.
Communication	• Communicates with other fleet managers to share waste minimization ideas and learn new techniques. • Shares technology with surrounding communities, DOE sites, and municipalities. • Uses resources provided by resident environmental experts, including training, technical knowledge and databases, recycling, processed waste assessments, presentations, and waste minimization plans.	• Shares ideas with other DOE sites. • Uses EPA hotlines for interpretation of regulations. • Communicates with the DOE and the site Environmental Coordinator.

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Table 3.10 Miscellaneous Waste Minimization Practices, continued

Methods	INEL	NTS
Oil procurement	• Working toward a closed-loop system. An ideal system would incorporate buying re-refined motor oil, using it for oil changes, recapturing the used oil, and selling it back to the re-refining vendor.	• Working toward a closed-loop system. An ideal system would incorporate buying re-refined motor oil, using it for oil changes, recapturing the used oil, and selling it back to the re-refining vendor.
Synthetic oil	• Investigating the use of petroleum-based synthetic oil instead of standard motor oil. The advantages of petroleum-based synthetic oils are that they: - have longer life between oil changes - can still be recycled.	• Not applicable.

☞ OUTCOME OF BENCHMARKING STEP 11:
Source reduction, recycle/recovery techniques, and best management practices were documented for improved waste minimization of DOE fleet maintenance operations.

3.12 Step 12: Continue to Conduct Benchmarking of Process

Ongoing Process

Normally, benchmarking is an ongoing process. The best waste minimization technology today may be outmoded and outclassed by new developments. This step is not currently being pursued because of cost and schedule constraints, but would be necessary for actual process improvements.

Changes Made by Participants

Through the benchmarking project, some of the participants learned new techniques and renewed their efforts to minimize waste streams at their facilities.

At the Y-12 plant, the Waste Minimization Coordinator is

- investigating the use of permanent filters with washable screens on several test vehicles
- investigating the use of synthetic oil
- reevaluating policies on oil change frequencies, with the long-range goal of cutting back on oil changes.

"We're more aware of our volume and looking at ways to reduce it," said the waste minimization coordinator. He also said that they are using benchmarking techniques to look at other waste streams generated in the vehicle maintenance area.

4.0 Conclusions and Recommendations

Results and Recommendations

Because results and recommendations are an integral part of the benchmarking effort, they are included in the main body of the report.

See Section 3.11 for the results of the benchmarking project for used motor oil.

Learning Process

The benchmarking process is also a learning process. As the project progresses, the most important quality for a team to have is the ability to be flexible, to shift gears, and to handle the unexpected. This section is written for benchmarking project leaders or team members to help them anticipate and hopefully avoid pitfalls in future benchmarking efforts.

4.1 Lessons Learned by the Project Leader

Modifying the Methodology

A full benchmark is a long and rigorous process; the team had to modify the benchmarking process to accommodate the needs of the customer, DOE management. Several steps of the benchmark process can be successfully modified but none can be eliminated. Implementation, which is a major part of traditional benchmarking, could not be accomplished with this project because the team used a consensus process rather than a specific process. The process information was gathered from a variety of sites so there was no way to write an implementation plan that would apply to more than one site.

Benchmarking teams need to be flexible and factor in lessons learned from previous benchmarking studies. For example, this project was done in parallel with the liquid photographic waste benchmarking project. Therefore, the team was not able to benefit from previous lessons learned. The liquid photographic waste project did not encounter the same difficulties as this project did in finding external partners. The used motor oil team had to rethink the process for the motor oil project. However, both projects were successful.

Broaden the Criteria and Potential Partner Pool

During Steps 8 and 9, when the team was gathering and analyzing process data from potential partners, the team discovered that it had made the criteria too specific to the DOE complex, which severely limited the possible pool of potential partners. In future projects, the project leader plans to make sure the criteria are broad enough to encompass partners that may **not** have similar day-to-day working environments, but may still have techniques and technologies that may be applied to DOE facilities.

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Broaden the Criteria and Potential Partner Pool, continued

The benchmarking process is not a "turn-the-crank" process. Following the roadmap provided by the steps does not guarantee a specific outcome. This was illustrated by the inability to find the right partners in the first cut of the partner search. To find more partners, the team would have had to repeat steps 5, 7, 8, and 9. Time and budget constraints did not allow for these steps to be repeated.

4.2 Lessons Learned from the Process Experts

Greatest Benefit

The process experts felt that the greatest benefit of the benchmarking process was the opportunity to network with their peers and share process and operation information.

Greatest Value

Process experts reported the following as the greatest value of the workshop to the DOE complex:

> "Hearing the processes and experience of the other participants as far as regulation, state, federal, DOE, and their own company's procedures."
>
> One process expert noted that waste minimization efforts are contagious and the effort in one area or process spreads to other areas. For example, one site is now directing efforts to buy all biodegradable materials and remove all aerosol products.
>
> "It's made me into a tyrant. I get things done now. I feel like I've really accomplished something."
>
> "You can see money being saved and less waste being generated. Knowledge is the key here. You have to know everything you possibly can about your process and then keep pushing to make it better."
>
> The benchmarking process lets people from across the DOE brainstorm and exchange ideas. "You can find out how other people are running their program, you can express your own ideas, and you don't have to worry about getting knocked down by upper management," said another participant. "Benchmarking gets you thinking about `Why do we have to do it this way?' and lets you try new ways."

Biggest Problems

The biggest problems encountered by the process experts included

- Logistics: getting to scheduled meetings
- Conflicting priorities with other work
- Understanding a generic process in light of differing regulatory requirements
- Thinking outside of the box—seeing things from a different viewpoint

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Appendix A
Telephone and Written Questionnaires

PREFACE: The following pages are copies of the

- telephone questionnaire used by the process experts to conduct the telephone interviews to narrow the field of potential partners. The first page of the telephone questionnaire contains information for the process expert about the purpose of the questionnaire. The second page provides a suggested "script" for the process expert to use to introduce him/herself. The telephone questionnaire follows, with a section for a table of contacts.

- written questionnaire sent to the potential partners selected through the telephone interviews. A cover letter tailored to each company accompanied the written questionnaire.

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Appendix B
Interview Question Set

Preface: The following list of questions was used by the interview team during site visits.

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Oil Interview Questions

1. Policy	What is your waste min mission statement?	
1	Who makes wmin decisions for motor oil at your site? Do they buy in?	
2. Volume/ type of oil and vehicles	Have you used synthetic oil successfully? How?	
2	How many pieces of equipment do you have?	
2	How much motor oil does your facility purchase annually?	
2	How much used motor oil does your facility produce annually?	
2	What is the volume of oil used per vehicle mile?	
2	What types of heavy equipment does your facility use?	
2	What types of motor oil do you use?	
2	What types of vehicles does your facility use?	

3. Filters	How often do you change filters?	
3	What kind of filters do you use?	
3	How do you dispose of your used filters?	
4. Service conditions and area	How many service areas do you have?	
4	What service conditions does your facility deal with?	
5. Oil Change	Have you extended your service frequencies? How?	
5	Have you found a way to get around manuf. warranty problems from extending service frequency?	
5	How do you analyze your oil to determine if it needs changing?	
5	Time: How often do you change the oil in vehicles?	

5	What drives your oil change policy?	
6. Disposal	Do you have a closed-loop system? Explain.	
6	Do you reuse oil? How?	
6	How do you dispose of your used motor oil?	
6	How do you recycle?	
7. Regulatory effects	Do you feel you are under any special regulatory constraints? If so, what are they?	
7	What kind of monitoring do you do?	

7	What regulations affect your waste min plan?	
7	What regulatory agencies do you work with?	
8. Other BMP	Any suggestions for solid waste associated with motor oil?	
8	Are there any wmin techniques or technologies that you would like to implement but do not now have the funds to do so?	
8	Do you have any ideas for minimizing used motor oil that have not yet been covered?	

8	Do you purchase reclaimed/re-refined oil? Who are your sources?	
8	How do you increase the efficiency of your motor pool operations?	
8	How can other DOE facilities handle their used motor oil in an environmentally responsible and economical way?	
8	What are all the different ways you have tried to handle used motor oil, both successfully and unsuccessfully?	
8	What BMPs do you implement?	
8	What BMP would you like to implement in the future?	

8	What do other DOE fleet managers need to know?	
9. Misc.	Can I publish this information and distribute it both within the DOE and outside?	
9	Should I publish inputs, outputs, customers, suppliers, generic process flow charts in my report?	
9	Do you do any bioremediation?	
9	Do you use any new technology?	
9	Do you have any WMin success stories you want to share?	
10. Costs	Cost and volume data for treatment, storage and disposal for used motor oil	

10	How much does treatment, storage, and disposal cost for your used motor oil?	
11. Trends	Trend analysis	